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## Public Employees Occupational Safety and Health Program

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# Occupational Noise Exposure and Hearing Conservation

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Do you have a problem hearing over the telephone?

Do you have trouble following the conversation when two or more people are talking at the same time?

Do people complain that you turn the TV volume up too high?

Do you have to strain to understand conversation?

Do you have trouble hearing in a noisy background?

Do you find yourself asking people to repeat themselves?

Do many people you talk to seem to mumble (or not speak clearly)?

Do you misunderstand what others are saying and respond inappropriately?

Do you have trouble understanding the speech of women and children?

Do people get annoyed because you misunderstand what they say?

If you answered "yes" to any of these questions you may be experiencing the symptoms of Noise Induced Hearing Loss (NIHL).

Noise is unwanted sound and is an extensive occupational health problem. More than 30 million Americans are exposed to hazardous sound levels on a regular basis. Unlike many occupational hazards, exposures to harmful sound levels can also occur in recreational settings, homes, almost anywhere. Thus, the effects of a work exposure may be aggravated by other activities. To protect hearing, people should take measures to limit or minimize all

exposures to harmful sound levels. This can be done by either controlling the sound source by reducing the level, by isolating the source or muffling the sound or by the use of personal protective equipment such as ear plugs or muffs.

Hearing loss occurs in two basic ways: conductive and sensorineural. Conductive hearing loss is caused by a problem with a part of the outer or

### Typical Sound Levels

Sound Source	Sound Level in dBA
Whisper	20—30
Normal Speech	60—70
Average Office	70—80
Average Telephone	80
Average Fire/Smoke Detector	85
Emergency Generators	100—120
Power saws and other wood working equipment	100—130
Power lawn mowers, leaf blowers and chain saws	100—130
Threshold of pain	140

middle ear. A breakdown or obstruction interferes with sound transmission. This type of hearing loss is common and can often be reversed and hearing restored with appropriate treatment. Sensorineural hearing loss occurs from changes in the receptor hair cells in the inner ear or in the nerves carrying impulses to the brain. This type of hearing loss is usually permanent.

Noise induced hearing loss (NIHL) is sensorineural and is usually permanent. Fortunately, workplace NIHL can be reduced or even eliminated by the successful application of an occupational hearing loss prevention program.

### **29 CFR 1910.95 Occupational Noise Exposure**

The Occupational Noise Exposure Standard requires that protection against the effects of noise exposure be provided when sound levels exceed those shown in the following table when measured on the “A” scale of a standard sound level meter at slow response. Table G-16 is the list of permissible noise exposures from the noise standard.

Table G-16— Permissible Noise Exposures

Duration per day, hours	Sound Level dBA
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4	115

The standard requires that feasible administrative or engineering controls be utilized when levels exceed those listed. If these controls fail to reduce the sound level to those listed, personal protective equipment must be provided and used to reduce sound levels to within the levels of the table.

If employee noise exposures equal or exceed an 8 hour time weighted average (TWA) of 85 dB measured on the “A” scale (slow response) or the equivalent 50 percent dose, the employer must administer a continuing, effective hearing conservation program as described in the Occupational Noise Exposure Standard.

### **Occupational Hearing Conservation Program**

An occupational hearing conservation program has seven (7) basic components:

1. Noise exposure monitoring
2. Administrative and engineering controls
3. Audiometric evaluation
4. Use of hearing protection devices (ear plugs and muffs)
5. Education and motivation
6. Record keeping, and
7. Program evaluation.

#### **Noise Exposure Monitoring**

The PEOSH Occupational Noise Exposure Standard, 29 CFR 1910.95, states that “When information indicates that any employee’s exposure may equal or exceed an 8 hour time weighted average of 85 decibels (dB) the employer shall develop and implement a monitoring program (29 CFR 1910.95(d)). The three most common methods of noise monitoring are area surveys, personal dosimetry and engineering surveys.

In an area survey, a sound level meter is used to measure environmental noise levels. This information may be used to identify areas where more thorough noise exposure evaluation is needed.

Personal dosimetry, a method of evaluating an employee’s individual exposure, is used to determine the noise levels experienced by employees throughout the work shift. A noise measuring instrument with the microphone positioned in the employee’s hearing zone is used to measure sound levels. OSHA defines the “hearing zone” as a two foot sphere around the employees head. This type of monitoring result can also represent the exposure of other workers whose exposures result from the same tasks.

#### **Noise Dose (Dose)**

The noise exposure is expressed as a percentage of the allowable daily exposure. For PEOSH, a 100% dose would equal an 8 hour exposure to a continuous 90 dBA noise, a 50% dose would equal an 8 hour exposure to an 85 dBA noise or a 4 hour exposure to 90 dBA noise.

During engineering surveys, octave band analyzers and sound level recorders are used to obtain information on the frequency/intensity composition of noise. This information can be used in assessing options for applying engineering controls.

### Administrative and Engineering Controls

Administrative and engineering controls can be used to reduce exposures to the point where the hazard is eliminated or reduced to manageable proportions. These control measures consist of removing the worker or removing the hazard. This may be accomplished by substituting less noisy equipment for instance.

Administrative controls include work scheduling and task assignment. Individual employee exposure is reduced by decreasing the amount of time spent in a noisy environment.

Engineering controls include mufflers, sound barriers, enclosures and sound absorbing materials. These either decrease levels through sound absorption or redirect the sound to unoccupied areas.

### Audiometric Evaluation

Audiometric evaluation is required if employees are exposed to sound levels equal to or exceeding an 8 hour TWA of 85 dB. This evaluation consists of a baseline audiogram obtained within 6 months of an employee's first exposure to levels of 85 dB or greater followed by yearly retesting. The baseline audiogram must be preceded by 14 hours without exposure to workplace noise.

The baseline audiogram is then compared to the most recent test to determine if the audiogram is valid and if a standard threshold shift (STS) has occurred in the employee's hearing.

A STS is defined as an average shift from baseline of 10 dB or more in the audiometric frequencies 2000, 3000, and 4000 Hz. In determining whether a STS has occurred an adjustment allowing for the contribution of aging (presbycusis) to hearing loss may be made. The procedure for this adjustment is described in Appendix F (Calculation and Application of Age Correction to Audiograms) of the Occupational Noise Exposure Standard.

A STS is a sign that the employee has begun to lose hearing and that intervention is needed to prevent further hearing loss. If an STS has occurred, the employer must notify the affected employee in writing within 21 days. Unless a physician determines that the shift is NOT work-related, the standard requires that the employer shall ensure that:

1. employees not wearing hearing protection are fitted and trained in their use and care and required to use them;
2. employees already using hearing protection shall be re-fitted and re-trained;
3. employees are provided with hearing protection providing greater attenuation if necessary;
4. employees are referred for further appropriate testing.

### Yearly audiograms

A yearly audiogram serves two main purposes. Individual employees who may have experienced an adverse reaction to occupational noise can be identified and follow up procedures to protect the employee can be instituted; and, the effectiveness of the hearing conservation programs can be measured.

### Hearing Protection

Personal protective equipment for hearing protection is of two basic types, ear plugs and muffs, and a variety of each type is available. The choice of hearing protection provided should be based on the sound levels present in the workplace where the hearing protection will be used. This level along with information about the noise reduction rating (NRR) of the hearing protection can be used to select adequate protection.

### Noise Reduction Rating

The Noise Reduction Rating is a single-number rating method that describes the protection provided by a hearing protector. It indicates how much the overall noise level is reduced by the hearing protector. Field studies by the National Institute for Occupational Safety and Health (NIOSH) have shown that employees normally achieve only about 1/2 of the noise reduction provided by hearing protection.

To correctly estimate the noise reduction provided by hearing protection devices, it is important to remember to *first* subtract 7 from the NRR and then subtract the remainder from the A-weighted noise level. Appendix B of 29 CFR 1910.95 requires this adjustment when assessing the adequacy hearing protection devices.

### Hearing Conservation Program Evaluation Checklist (adapted from NIOSH)

#### Training and Education

Failures or deficiencies in hearing conservation programs (hearing loss prevention programs) can often be traced to inadequacies in the training and education of noise-exposed employees and those who conduct elements of the program.

1. Has training been conducted at least once a year?
2. Was the training provided by a qualified instructor?
3. Was the success of each training program evaluated?
4. Is the content revised periodically?
5. Are managers and supervisors directly involved?
6. Are posters, regulations, handouts, and employee newsletters used as supplements?

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7. Are personal counseling sessions conducted for employees having problems with hearing protection devices or showing hearing threshold shifts?

### **Supervisor Involvement**

Data indicate that employees who refuse to wear hearing protectors or who fail to show up for hearing tests frequently work for supervisors who are not totally committed to the hearing loss prevention programs.

1. Have supervisors been provided with the knowledge required to supervise the use and care of hearing protectors worn by subordinates?
2. Do supervisors wear hearing protectors in appropriate areas?
3. Have supervisors been counseled when employees resist wearing hearing protectors or fail to show up for hearing tests?
4. Are disciplinary actions enforced when employees repeatedly refuse to wear hearing protectors?

### **Noise Measurement**

1. Were the essential/critical noise studies performed?
2. Was the purpose of each noise study clearly stated? Have noise-exposed employees been notified of their exposures and appraised of auditory risks?
3. Are the results routinely transmitted to supervisors and other key individuals?
4. Are results entered into health/medical records of noise exposed employees?
5. Are results entered into shop folders?
6. If noise maps exist, are they used by the proper staff?
7. Are noise measurement results considered when contemplating procurement of new equipment? Modifying the facility? Relocating employees?
8. Have there been changes in areas, equipment, or processes that have altered noise exposure? Have follow-up noise measurements been conducted?
9. Are appropriate steps taken to include (or exclude) employees in the hearing loss prevention programs whose exposures have changed significantly?

### **Engineering and Administrative Controls**

Controlling noise by engineering and administrative methods is often the most effective means of reducing or eliminating the hazard. In some cases engineering controls will remove requirements for other components of the program, such as audiometric testing and the use of hearing protectors.

1. Have noise control needs been prioritized?
2. Has the cost-effectiveness of various options been addressed?

3. Are employees and supervisors appraised of plans for noise control measures? Are they consulted on various approaches?
4. Will in-house resources or outside consultants perform the work?
5. Have employees and supervisors been counseled on the operation and maintenance of noise control devices?
6. Are noise control projects monitored to ensure timely completion?
7. Has the full potential for administrative controls been evaluated? Are noisy processes conducted during shifts with fewer employees? Do employees have sound-treated lunch or break areas?

### **Monitoring Audiometry and Record Keeping**

The skills of audiometric technicians, the status of the audiometer, and the quality of audiometric test records are crucial to hearing loss prevention program success. Useful information may be obtained from the audiometric records as well as from those who actually administer the tests.

1. Has the audiometric technician been adequately trained, certified, and recertified as necessary?
2. Do on-the-job observations of the technicians indicate that they perform a thorough and valid audiometric test, instruct and consult the employee effectively, and keep appropriate records?
3. Are records complete?
4. Are follow-up actions documented?
5. Are hearing threshold levels reasonably consistent from test to test? If not, are the reasons for inconsistencies investigated promptly?
6. Are the annual test results compared to baseline to identify the presence of an PEOSH standard threshold shift?
7. Is the annual incidence of standard threshold shift greater than a few percent? If so, are problem areas pinpointed and remedial steps taken?
8. Are audiometric trends (deteriorations) being identified, both in individuals and in groups of employees? (NIOSH recommends no more than 5% of workers showing 15 dB Significant Threshold Shift, same ear, same frequency.)
9. Do records show that appropriate audiometer calibration procedures have been followed?
10. Is there documentation showing that the background sound levels in the audiometer room were low enough to permit valid testing?
11. Are the results of audiometric tests being communicated to supervisors and managers as well as to employees?
12. Has corrective action been taken if the rate of no-shows for audiometric test appointments is more than about 5%?
13. Are employees incurring STS notified in writing within at least 21 days? (NIOSH recommends immediate notification if retest shows 15 dB Significant Threshold Shift, same ear, same frequency.)

### Referrals

Referrals to outside sources for consultation or treatment are sometimes in order, but they can be an expensive element of the hearing loss prevention program, and should not be undertaken unnecessarily.

1. Are referral procedures clearly specified?
2. Have letters of agreement between the company and consulting physicians or audiologists been executed?
3. Have mechanisms been established to ensure that employees needing evaluation or treatment actually receive the service (i.e., transportation, scheduling, reminders)?
4. Are records properly transmitted to the physician or audiologist, and back to the company?
5. If medical treatment is recommended, does the employee understand the condition requiring treatment, the recommendation, and methods of obtaining such treatment?
6. Are employees being referred unnecessarily?

### Hearing Protection Devices

When noise control measures are infeasible, or until such time as they are in effect, hearing protection devices are the only way to prevent hazardous levels of noise from damaging the inner ear. Making sure that these devices are worn effectively requires continuous attention on the part of supervisors and program implementors as well as noise-exposed employees.

1. Have hearing protectors been made available to all employees whose daily average noise exposures are 85 dBA or above? (NIOSH recommends requiring hearing protection use if noises equal or exceed 85 dBA regardless of exposure time.)
2. Are employees given the opportunity to select from a variety of appropriate protectors?
3. Are employees fitted carefully with special attention to comfort?
4. Are employees thoroughly trained, not only initially but at least once a year?
5. Are the protectors checked regularly for wear or defects, and replaced immediately if necessary?
6. If employees use disposable hearing protectors, are replacements readily available?
7. Do employees understand the appropriate hygiene requirements?
8. Have any employees developed ear infections or irritations associated with the use of hearing protectors? Are there any employees who are unable to wear these devices because of medical conditions? Have these conditions been treated promptly and successfully?
9. Have alternative types of hearing protectors been considered when problems with current devices are experienced?

10. Do employees who incur noise-induced hearing loss receive intensive counseling?
11. Are those who fit and supervise the wearing of hearing protectors competent to deal with the many problems that can occur?
12. Do workers complain that protectors interfere with their ability to do their jobs? Do they interfere with spoken instructions or warning signals? Are these complaints followed promptly with counseling, noise control, or other measures?
13. Are employees encouraged to take their hearing protectors home if they engage in noisy non-occupational activities?
14. Are new types of or potentially more effective protectors considered as they become available?
15. Is the effectiveness of the hearing protector program evaluated regularly?
16. Have at-the-ear protection levels been evaluated to ensure that either over or under protection has been adequately balanced according to the anticipated ambient noise levels?
17. Is each hearing protector user required to demonstrate that he or she understands how to use and care for the protector? Are the results documented?

### Administrative

Keeping organized and current on administrative matters will help the program run smoothly.

1. Have there been any changes in federal or state regulations? Have hearing loss prevention program's policies been modified to reflect these changes?
2. Are copies of company policies and guidelines regarding the hearing loss prevention program available in the offices that support the various program elements? Are those who implement the program elements aware of these policies? Do they comply?
3. Are necessary materials and supplies being ordered with a minimum of delay?
4. Are procurement officers overriding the hearing loss prevention program implementor's requests for specific hearing protectors or other hearing loss prevention equipment? If so, have corrective steps been taken?
5. Is the performance of key personnel evaluated periodically? If such performance is found to be less than acceptable, are steps taken to correct the situation?
6. Safety: Has the failure to hear warning shouts or alarms been tied to any accidents or injuries? If so, have remedial steps been taken?

## How noise is measured

60-70 dBA - Normal conversation

85 dBA - Hearing conservation program

90 dBA - 8 hour exposure limit

95 dBA - 4 hour exposure limit

100 dBA - 2 hour exposure limit

105 dBA - 1 hour exposure limit

110 dBA - 1/2 hour exposure limit

115 dBA - 1/4 hour exposure limit

**Decibel (dB):** A unit of measurement expressing the magnitude of the measured sound relative to the reference sound. (The "reference sound" is roughly equal to the weakest sound pressure the human ear can hear at the frequencies where the human ear is the most sensitive.)

For compliance purposes a decibel increase of 5 is equal to a doubling of the noise level. Thus, 90 dB is two times the noise level represented by 85 dB.

**"A" weighted (dBA):**

Levels measured with a sound meter equipped to filter out some low frequency and very high frequency sounds, similar to the way the human ear perceives sound of medium intensity.

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Occupational Safety and Health Administration  
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<http://www.osha.gov>

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Centers for Disease Control and Prevention  
U.S. Department of Health and Human Services  
<http://www.cdc.gov>

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Useful Internet Links with information about Hearing Conservation

[www.nidcd.nih.gov](http://www.nidcd.nih.gov)  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh)  
[www.hearingconversation.org](http://www.hearingconversation.org)

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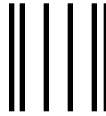
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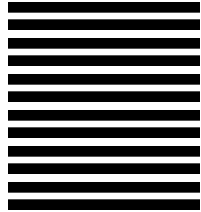
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